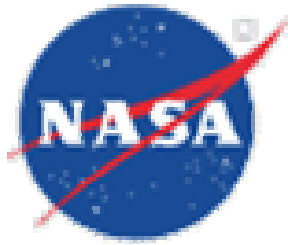

DISCOVERing Online Data and Services

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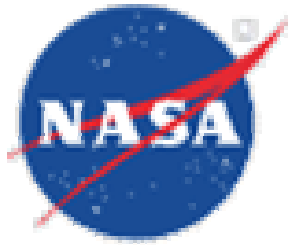
Distributed Information Services: Climate/Ocean Products for Earth Research (DISCOVER)



- A REASoN collaboration between Remote Sensing Systems, NASA and the University of Alabama in Huntsville
  - 5 year project starting April 2004
- Science goals
  - Multi satellite inter-calibration and cross-validation
  - Highly accurate, long term ocean and climate products
- IT goals
  - On-line services for data access and visualization
  - Interoperability technologies for improved data usability
  - Flexible architecture to adapt to changing user requirements

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Key Personnel

- Project Coordinator
  - Michael Goodman – Co-I, NASA/MSFC
- Atmospheric Science
  - Frank Wentz – PI, RSS
  - Roy Spencer – Co-I, UAH
- Information Technology
  - Sara Graves – Co-I, UAH
  - Helen Conover – technical lead
  - Ken Keiser – data pool development

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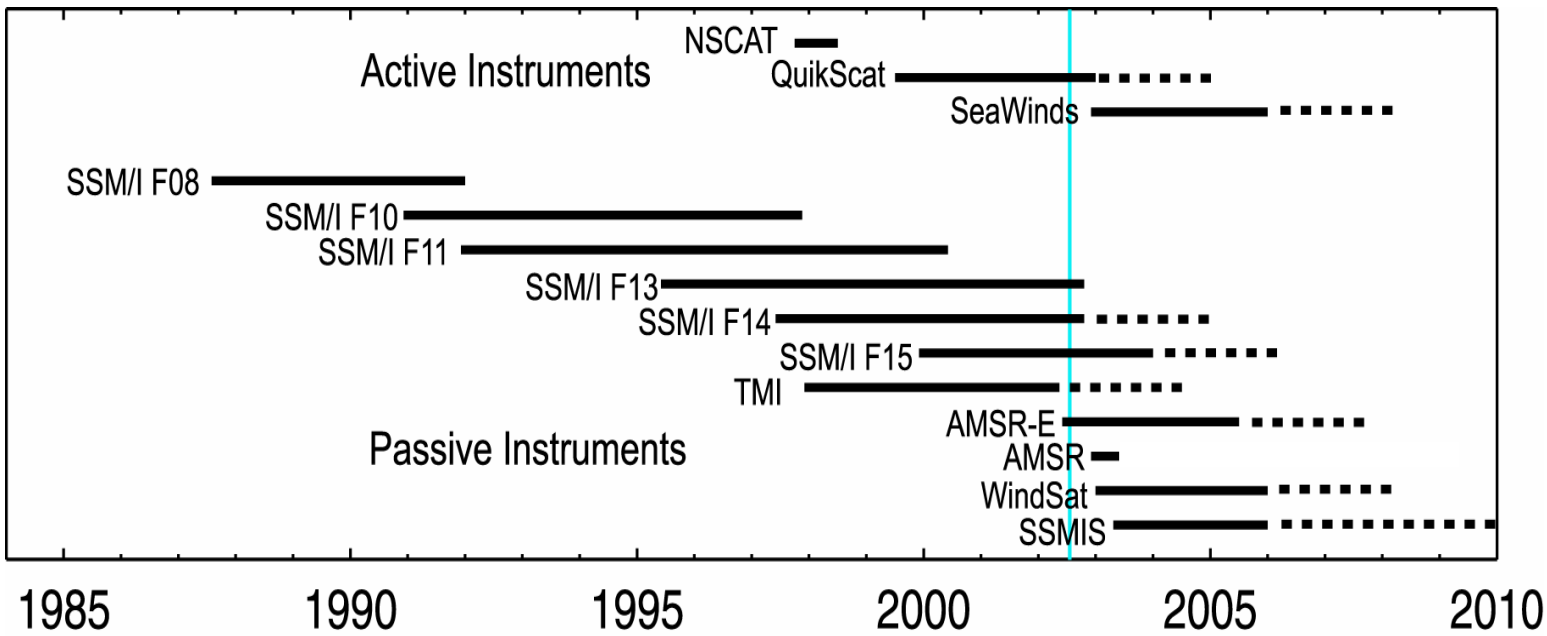
Long Term Systematic Measurements

Merging multiple sensors from multiple platforms into geophysical data sets consistent in both space and time to produce highly accurate, long-term ocean and climate products

- 27 microwave satellite instruments from the past, present, and future



Periods of operation for microwave instruments that can retrieve ocean surface winds

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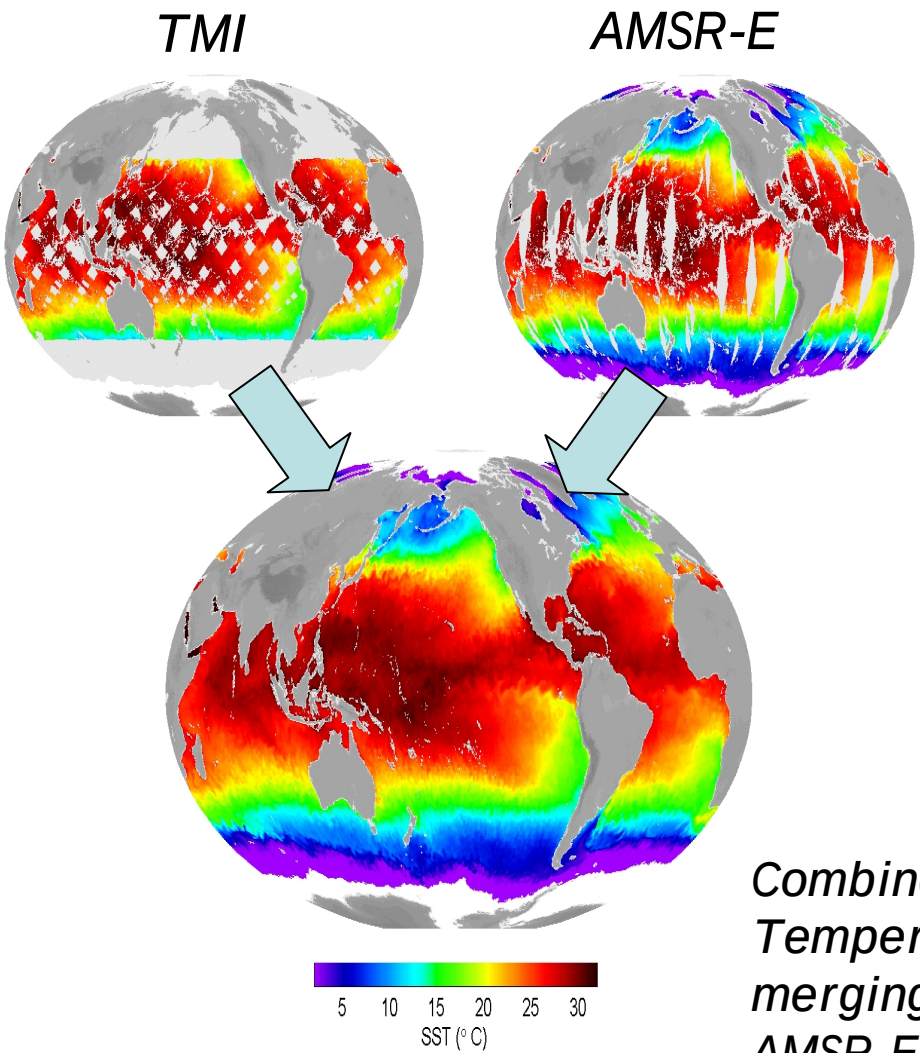
DISCOVER Data Products



Combined Product

Data products include:

- Brightness temperatures
- Sea surface temperature
- Wind speed
- Air temperature
- Atmospheric water vapor
- Cloud liquid water
- Rain rate

Combined Sea Surface Temperature product merging data from TMI and AMSR-E available now

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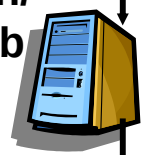
DISCOVER Information Products: Mining to Detect Tropical Cyclones

Advanced Microwave Sounding Unit (AMSU-A) Data

Calibration/ Limb Correction/ Converted to Tb



Data Archive

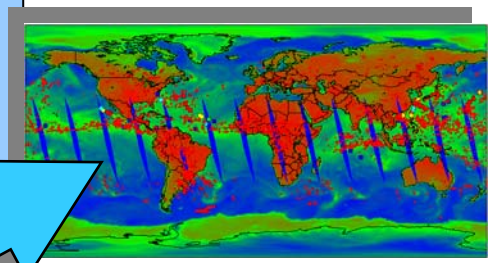
ADaM Mining Environment

Mining Plan:

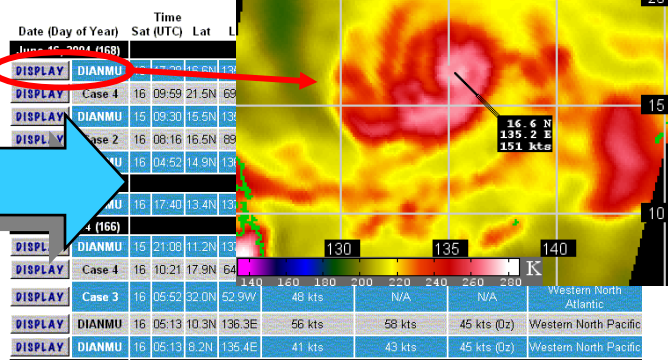
- Water cover mask to eliminate land
- Laplacian filter to compute temperature gradients
- Science Algorithm to estimate wind speed
- Contiguous regions with wind speeds above a desired threshold identified
- Additional test to eliminate false positives
- Maximum wind speed and location produced

Knowledge Base

Further Analysis



Result



Results are placed on the web, made available to National Hurricane Center & Joint Typhoon Warning Center, and stored for further analysis

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IT for DISCOVER

- IT goals
  - On-line services for data access and visualization
  - Interoperability technologies for improved usability
  - Flexible architecture to adapt to changing user requirements
- IT Approach
  - Exploring new technologies
  - Integrating them into DISCOVER information system
  - Hardening selected tools and making them available to the wider community

DATA POOL

- On-line data access with integrated data services
- Automated ordering, visualization, packaging and delivery of scientific data
- Multiple distributed repositories at UAH and RSS
- Common user interface, data catalog and order tracking

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DATA POOL

- Data Pool Navigation Options:
  - Search via keyword and geotemporal location
  - Browse via calendar
  - Browse data directories
  - Search Unidata THREDDS catalog
- Data Access Services:
  - FTP and HTTP
  - OPeNDAP
  - OGC WMS and WCS
- Data Packaging Services:
  - Subsetting
  - Re-formatting
  - Bundling

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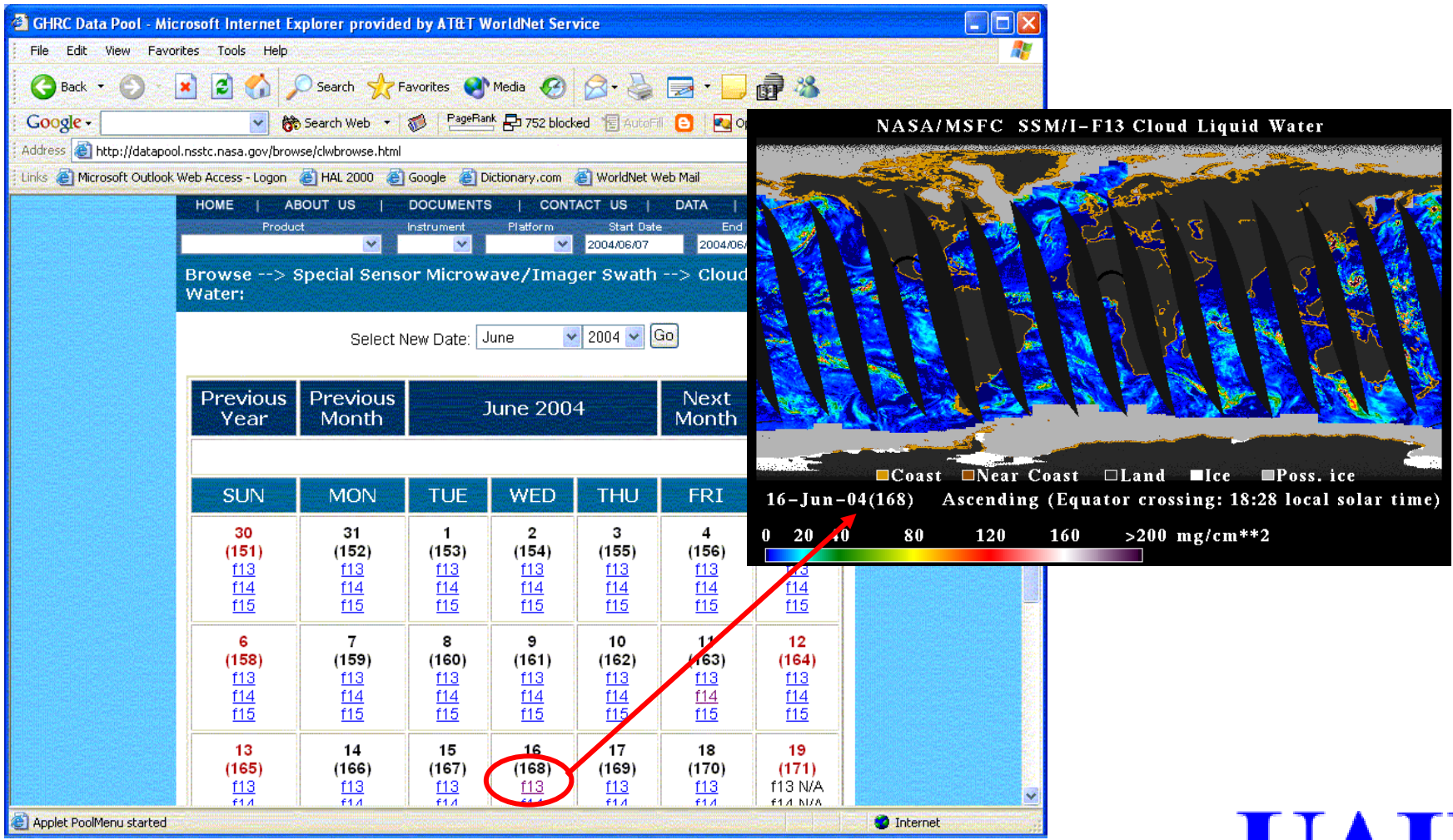
Calendar Interface



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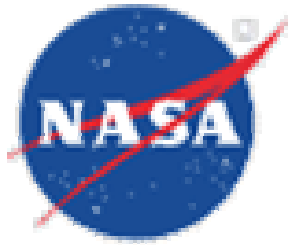
DISCOVER Data Pool Foundation Technology: ESML



- DISCOVER is data format neutral
  - Products generated in space-efficient binary format
  - Earth Science Markup Language (ESML) is used to provide full descriptions of data syntax
  - Translators can be provided to convert data to other popular formats as needed
  - ESML is the basis for dataset independent services implemented and planned for DISCOVER

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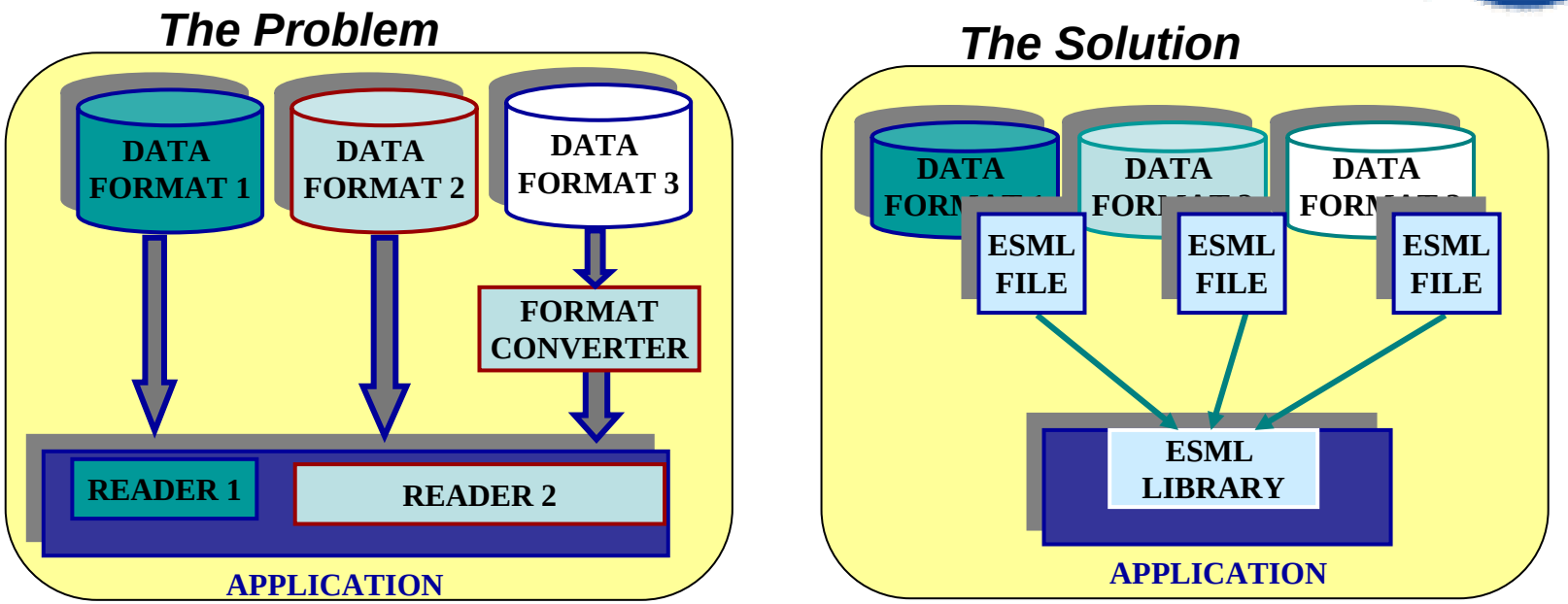
Emphasis on Interoperability: Accessing and Using Heterogeneous Data



- One approach: Standard data format
  - Difficult to implement and enforce
  - Can't anticipate all needs
    - Some data can't be modeled or is lost in translation
  - Costly to convert legacy data
- **A better approach: Interchange Technologies**
  - **Earth Science Markup Language**

What is ESML?

- It is a **specialized markup language** for Earth Science metadata based on XML - *NOT* another data format.
- It is a machine-readable and -interpretable representation of the **structure, semantics and content** of any data file, regardless of data format
- ESML description files contain **external metadata** that can be generated by either data producer or data consumer (at collection, data set, and/or granule level)
- ESML provides the **benefits of a standard, self-describing data format** (like HDF, HDF-EOS, netCDF, geoTIFF, …) without the cost of data conversion
- ESML is the basis for **core Interchange Technology** that allows data/application interoperability
- ESML **complements and extends data catalogs** such as EDG and GCMD by providing the use/access information those directories lack.

Current Status

ESML data formats

- Currently supported
  - ASCII, Binary, HDF-EOS, netCDF, NEXRAD Level II, Grib, HDF5
- In work
  - GeoTIFF

ESML Editor and Data Browser applications

ESML Library

- Currently available
  - C++ for Windows and Linux, Python bindings, IDL plugin
- Being tested
  - OPeNDAP/DODS Server
- In work
  - Subsetting Library
  - Expanded semantic support

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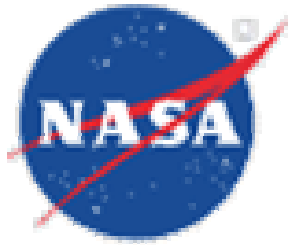
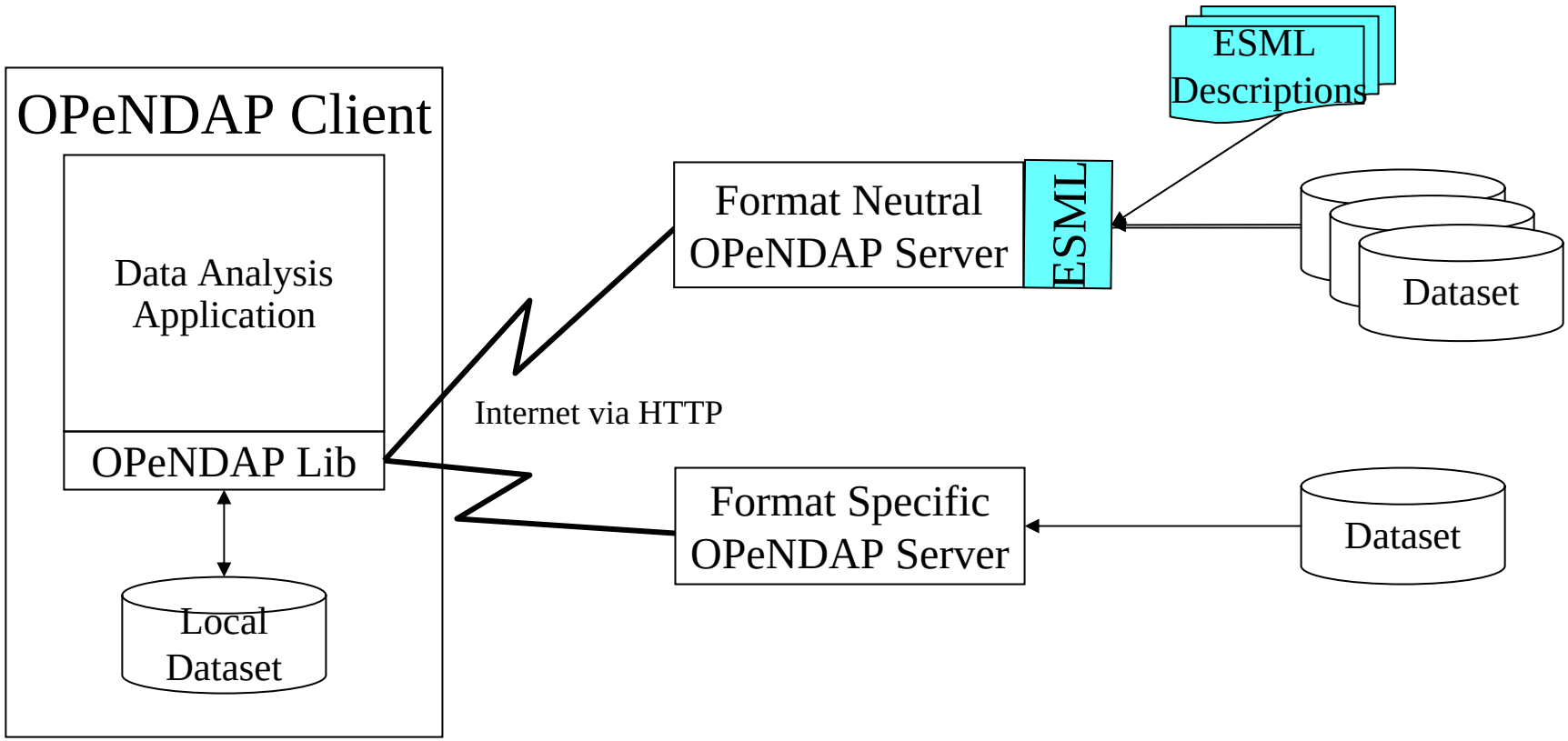
ESML-OPeNDAP Data Server

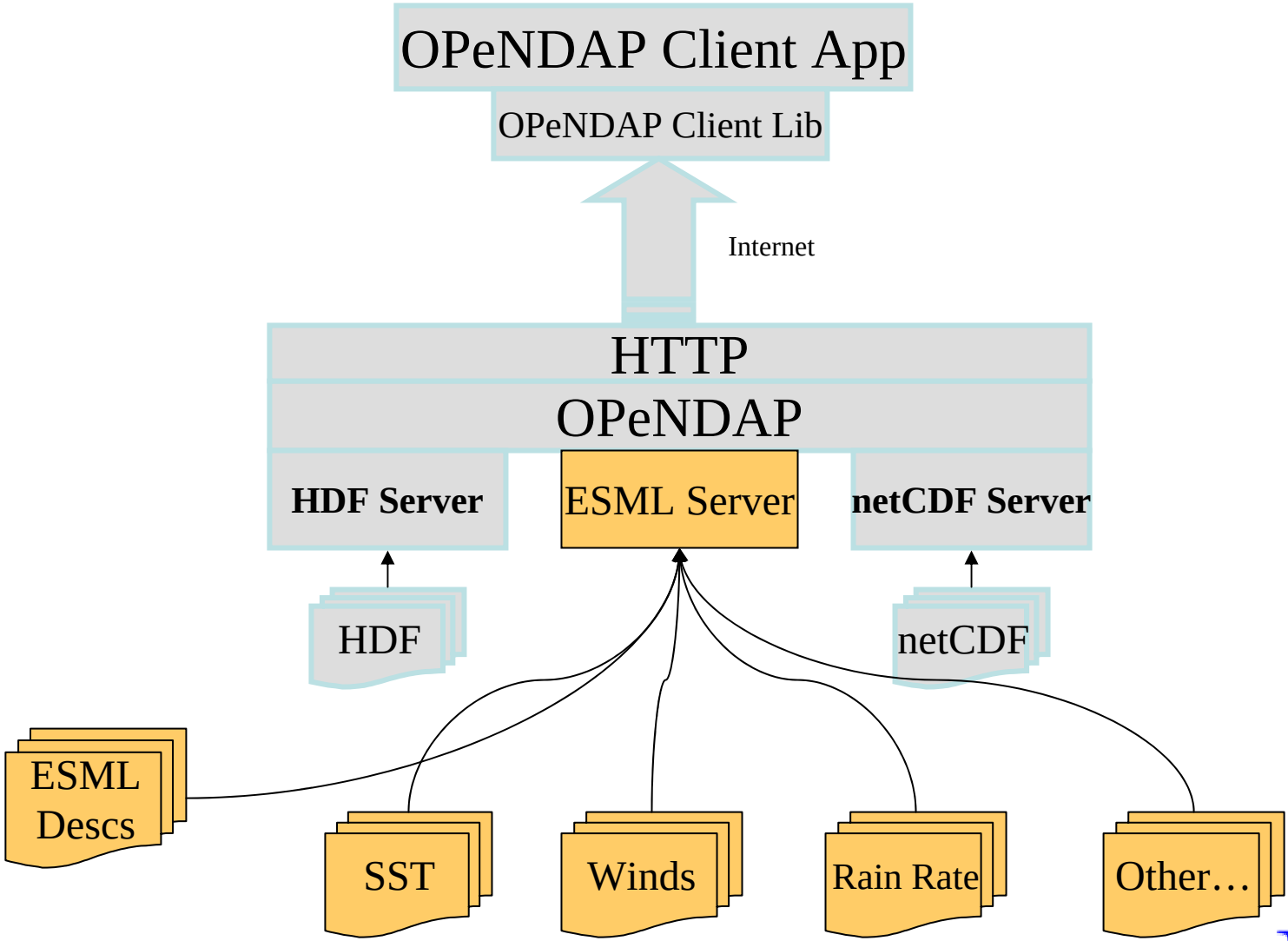


- OPeNDAP data transport
  - Servers for each data type
  - Clients for each application
- ESML adds layer of abstraction to data server
  - Single ESML-OPeNDAP server for multiple data types
  - Simplifies set-up and maintenance for data provider
  - New OPeNDAP server not required if ESML already supports a data type that OPeNDAP doesn't – e.g., GeoTIFF
- Leveraging two maturing, NASA-funded technologies to provide added interoperability

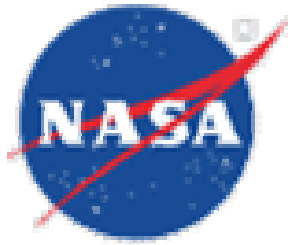
OPeNDAP Architecture



ESML-OPeNDAP Server



ESML- OPeNDAP status and availability



- Currently beta testing with DODS / OPeNDAP developers and others
- ITSC test installation is providing
  - TMI Ocean products(in HDF-EOS format)
  - Nexrad Level II radar volume scans
  - SAGE (binary)

    http://moby.itsc.uah.edu/cgi-bin/msud/esml/nph-dods/msud
- Beta test package

  http://www.itsc.uah.edu/~keiser/DODS-ESML

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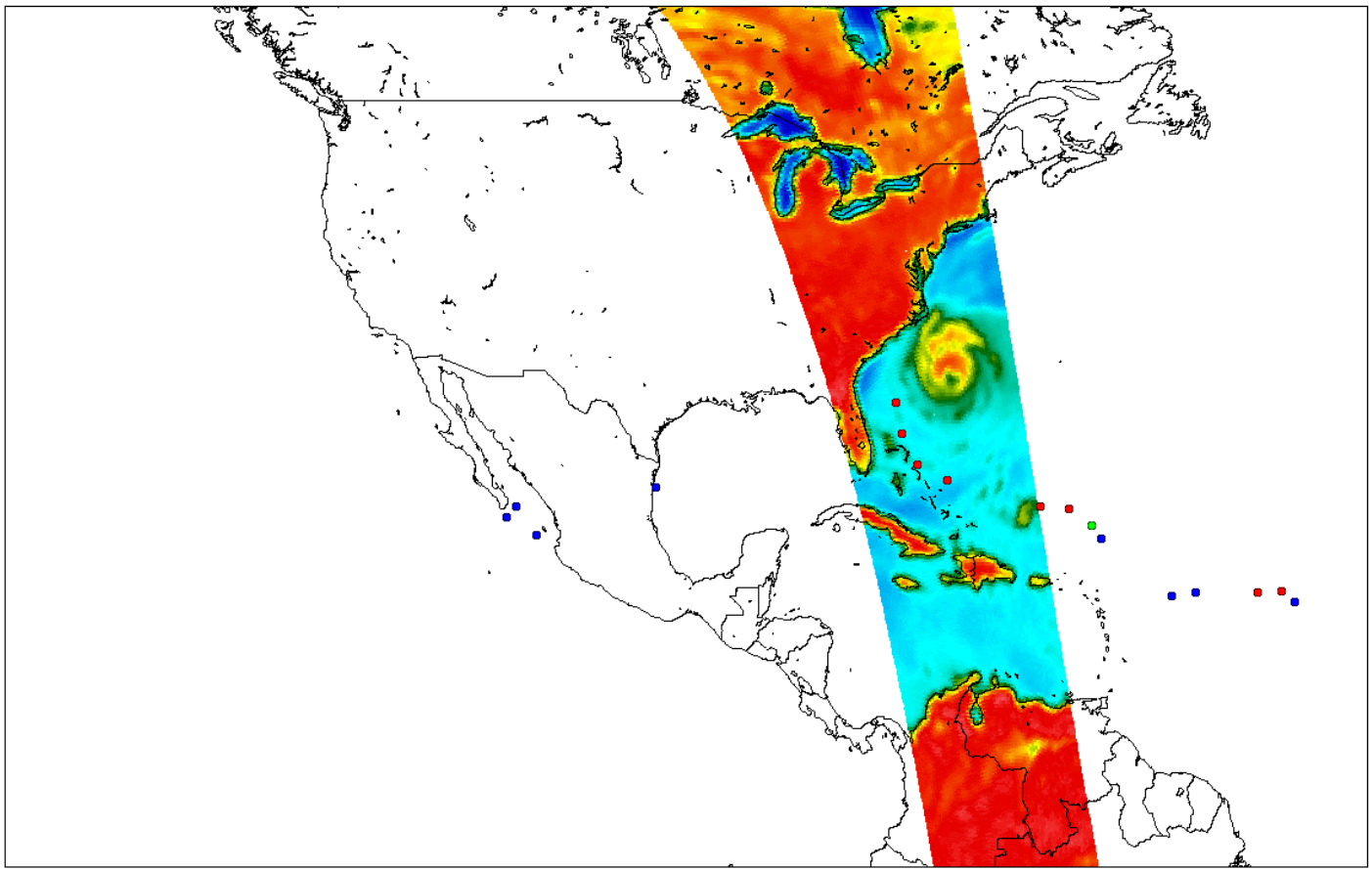
OGC Web Services

- Using OpenGIS Consortium standard Web Services protocols to access data
  - Web Map Services to visually overlay data layers to create merged images
    - DISCOVER data products, mined events (e.g., cyclones), geographic boundaries, data from other sources
  - Web Coverage Services to transmit science data, possibly using ESML to describe data structures
    - UAH is participating in continued refinement of the WCS specification

OGC Web Services



Selected SSM/I Tb swath overlaid with mined cyclones from September 2003

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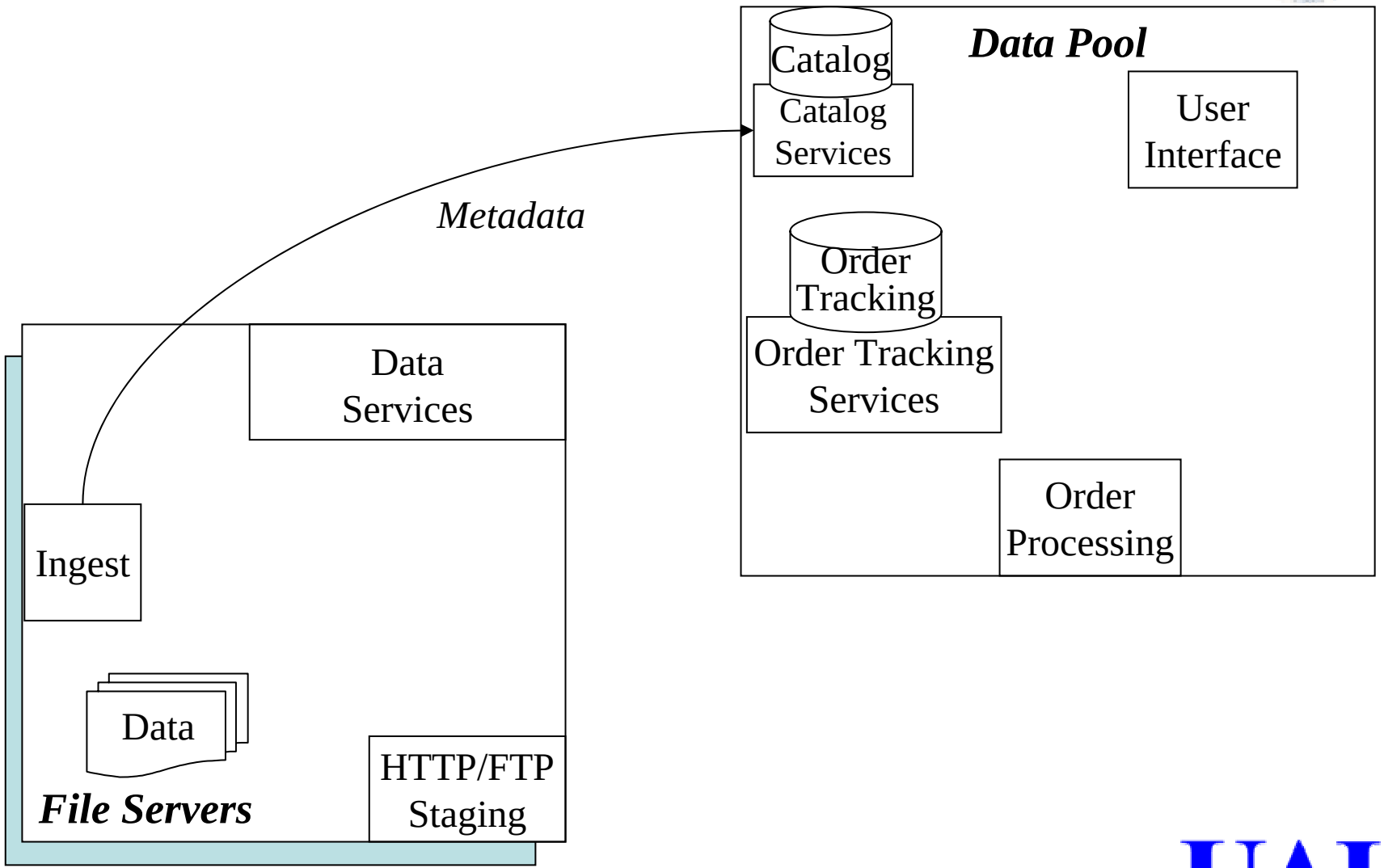
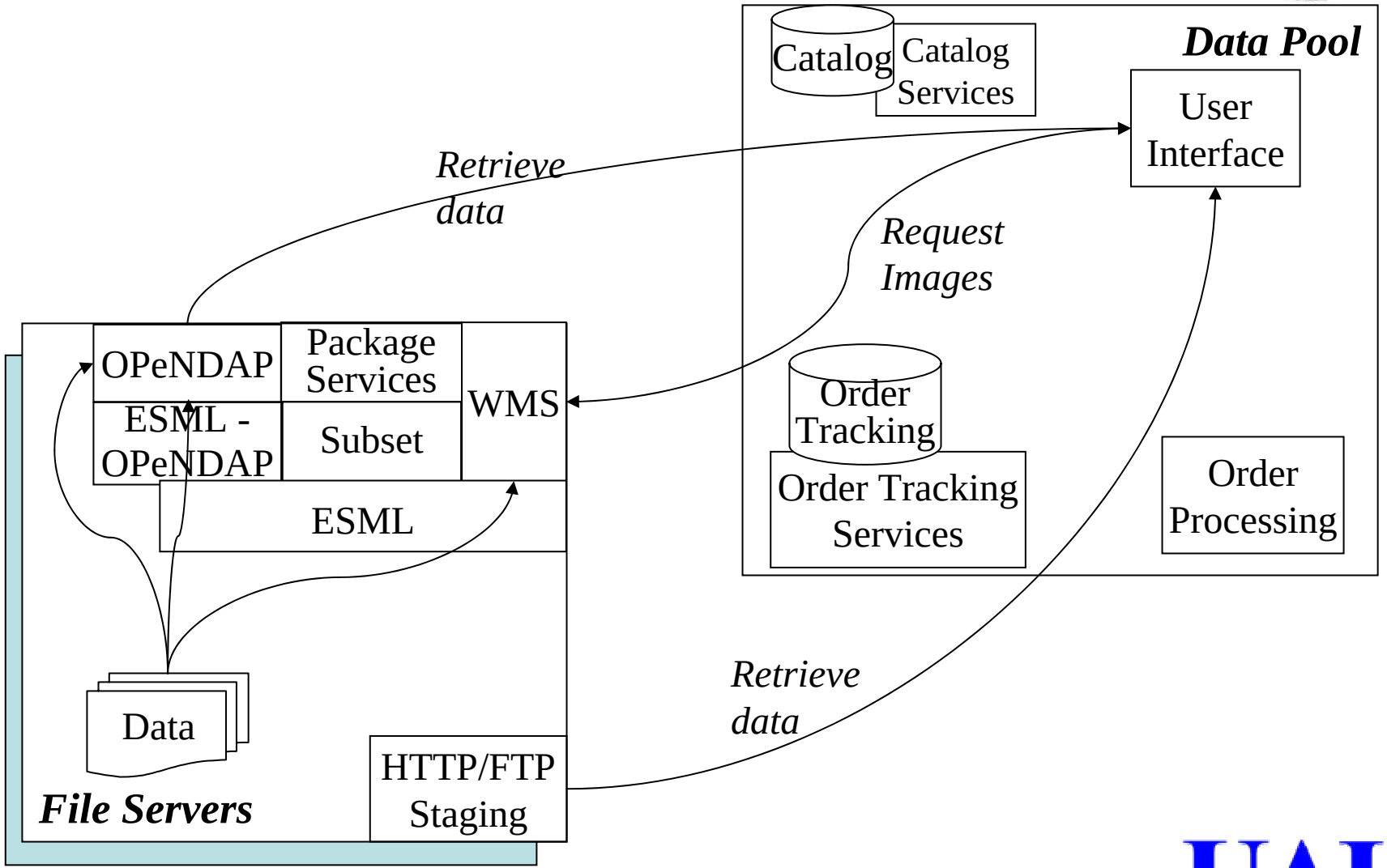
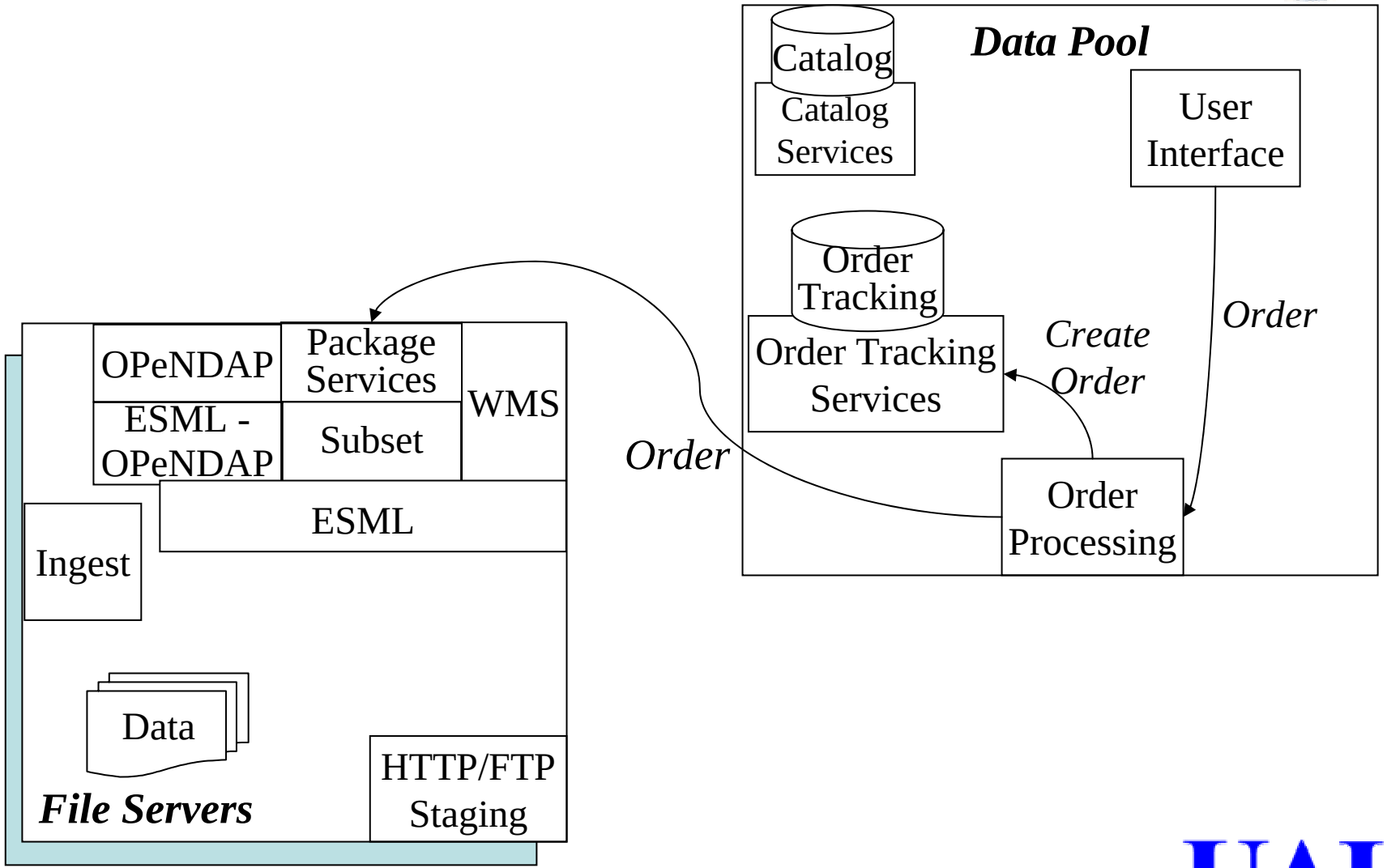
Data Pool – Architecture (1)



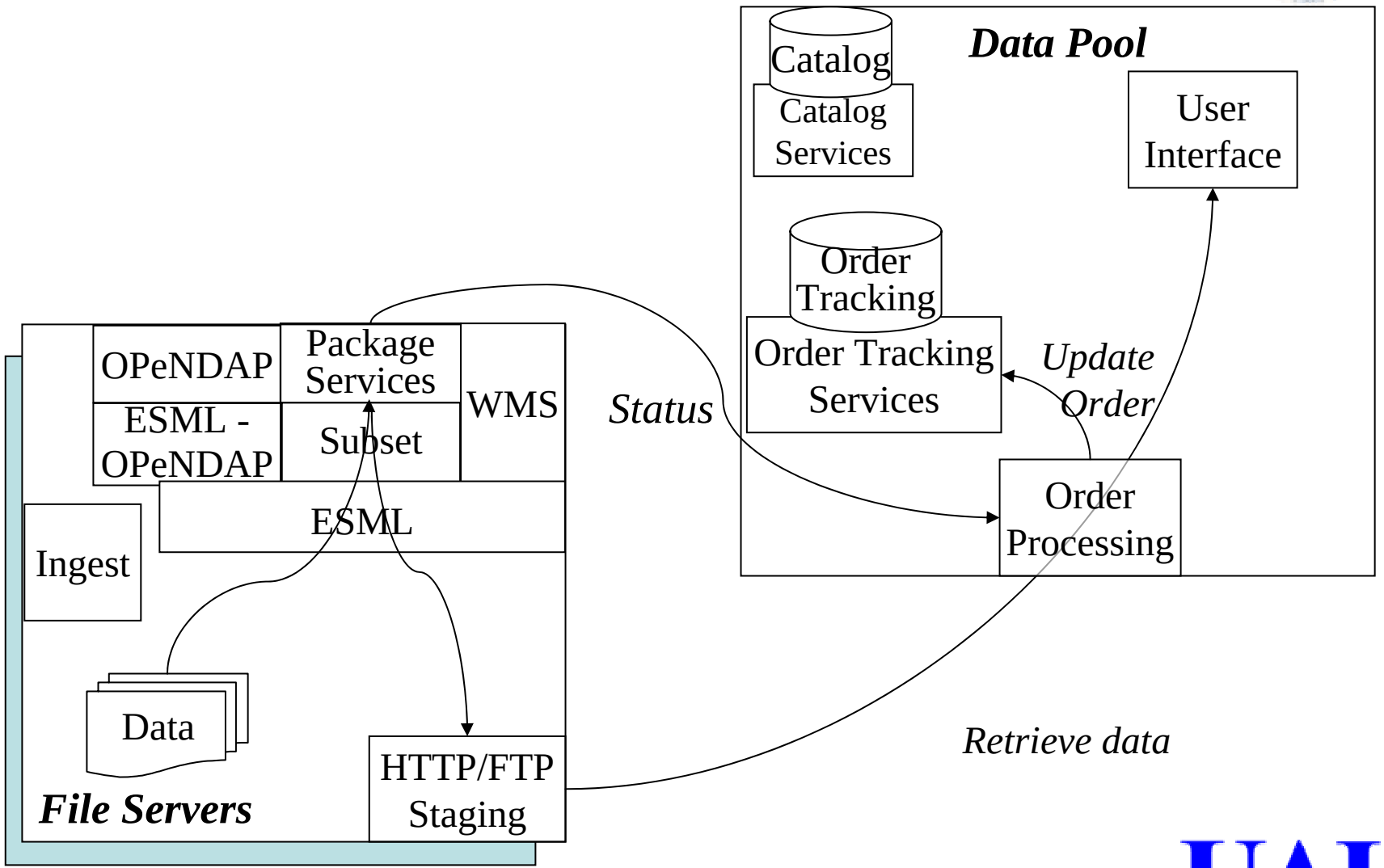
Data Pool – Architecture (2)



Data Pool – Architecture (3)



Data Pool – Architecture (4)



Data pool status and plans

- Initial version of DISCOVER Data Pool in beta test; expect to release this summer
  - Multiple search, browse and data access navigation paths
  - Initial subsetting and data packaging services
  - Integrated order tracking
  - OPeNDAP / DODS access
  - UAH-hosted datasets
- In work
  - Catalog and provide services for RSS-hosted data
  - Incorporate additional subsetting tools
  - Integrate WMS / WCS services
- Next steps
  - Additional ESML-based services
  - Updates and enhancements based on user requirements

http://www.discover-earth.org/

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